NASA SBIR/STTR Technologies

S3.07-8767 - Spacecraft Thermal Control System Not Requiring Power

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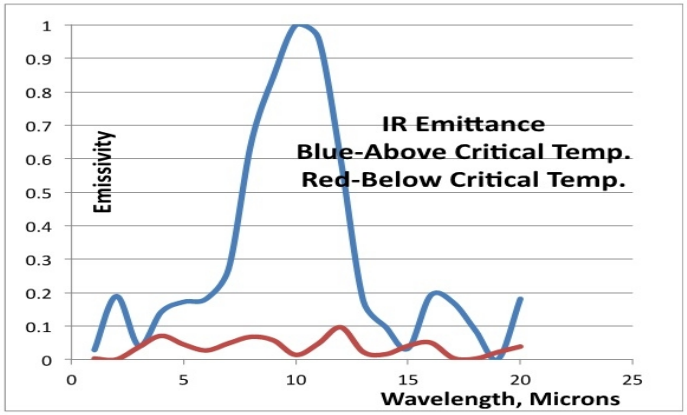
Identification and Significance of Innovation

Thermal control of spacecraft will be enhanced by a reconfigurable emittance film which is radiatively insulating below a threshold temperature and strongly emissive above the threshold. Triton Systems proposes a unique combination of plasmonics and materials technologies, to design, fabricate and characterize a self-switching infrared radiation control film which acts as a thermostat for spacecraft. The film is very light weight and no external power is required, and the critical temperature and emittance spectrum may be tuned to meet NASA specific requirements to fit different platforms and missions. Triton Systems has significant experience in innovative dynamic infrared metamaterials design and fabrication. The Figure shows schematically the emissivity spectrum of the control film above (blue) and below (red) the critical temperature.



Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

In Phase I, Triton plans to demonstrate by direct laboratory experimentation that two key features of the proposed thermal control film are feasible. First, the self-switching of the emittance properties at a transition temperature will be shown. Second, the ability to change the transition temperature by materials science and deposition techniques will be demonstrated. A detailed computational model and simulation will allow the design envelope to be completed. Finally, experimental laboratory measurements using an imaging FTIR will verify the properties. Based on this analysis and experimental demonstration, in Phase II we propose to develop a customized material design for a specific NASA mission requirement, and also demonstrate how to manufacture the film in a roll-to-roll process for low cost and high uniformity.

NASA Applications

NASA space platforms, from low earth orbit to deep space, all require thermal control. The Triton film technology is conformal and easily retrofitted to curved surfaces. Different film parameters including emittance spectrum and transition temperature can be designed for different missions, or even different surfaces on the same spacecraft. No external power is required. The film is very light in weight.

Non-NASA Applications

Defense applications of emittance control films include thermal signature modification for ships, aircraft, UAVs and land vehicles. Commercial applications are for thermophotovoltaics, or architectural energy control for roofs, windows and walls.

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